



Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

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CHEMISTRY

0620/31

Paper 3 (Extended)

October/November 2015

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.

A copy of the Periodic Table is printed on page 12.

You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

This document consists of **12** printed pages.



2

1 (a) The symbols of six particles are shown below.



Select from the list of particles to answer the following questions. A particle may be selected once, more than once or not at all.

(i) Which **two** ions have the same electronic structure? [1]

(ii) Which ion has the same electronic structure as an atom of argon? [1]

(iii) Which atom can form an ion of the type X³⁻? [1]

(iv) Which atom can form a hydride which has a formula of the type XH₄? [1]

(b) (i) How many protons, neutrons and electrons are there in one copper(II) ion ${}^{64}_{29}\text{Cu}^{2+}$?

number of protons

number of neutrons

number of electrons

[2]

(ii) ${}^{45}_{21}\text{Sc}$ represents an atom of scandium.

How many nucleons and how many charged particles are there in one atom of scandium?

number of nucleons

number of charged particles

[2]

(c) Two different atoms of sodium are ${}^{23}_{11}\text{Na}$ and ${}^{24}_{11}\text{Na}$.

(i) Explain why these two atoms are isotopes.

.....

..... [2]

(ii) ${}^{24}_{11}\text{Na}$ is radioactive. It changes into an atom of a different element which has one more proton.

Identify this element.

..... [1]

(iii) State **two** uses of radioactive isotopes.

.....

..... [2]

[Total: 13]

3

2 Describe how to separate the following. In each example, give a description of the procedure used and explain why this method works.

(a) Copper powder from a mixture containing copper and zinc powders.

procedure

.....

explanation

.....

[3]

(b) Nitrogen from a mixture of nitrogen and oxygen.

procedure

.....

explanation

.....

[3]

(c) Glycine from a mixture of the two amino acids glycine and alanine. Glycine has the lower R_f value.

procedure

.....

explanation

.....

[2]

(d) Magnesium hydroxide from a mixture of magnesium hydroxide and zinc hydroxide.

procedure

.....

explanation

.....

[3]

[Total: 11]

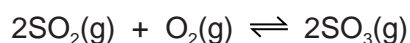
3 Sulfuric acid is made by the Contact process.

(a) Sulfur is burned by spraying droplets of molten sulfur into air.

Suggest and explain an advantage of using this method.

.....
 [2]

(b) The following equation represents the equilibrium in the Contact process.



Oxygen is supplied from the air.

The composition of the reaction mixture is 1 volume of sulfur dioxide to 1 volume of oxygen.

What volume of air contains 1 dm³ of oxygen?

..... dm³ [1]

(c) Sulfur dioxide is more expensive than air.

What is the advantage of using an excess of air?

.....
 [2]

(d) The forward reaction is exothermic. The reaction is usually carried out at a temperature between 400 and 450 °C.

(i) What is the effect on the position of equilibrium of using a temperature above 450 °C?
 Explain your answer.

.....

 [2]

(ii) What is the effect on the rate of using a temperature below 400 °C?
 Explain your answer.

.....

 [3]

5

(e) A low pressure, 2 atmospheres, is used. At equilibrium, about 98% SO_3 is present.

(i) What is the effect on the position of equilibrium of using a higher pressure?

..... [1]

(ii) Explain why a higher pressure is **not** used.

..... [1]

(f) Name the catalyst used in the Contact process.

..... [1]

(g) Describe how concentrated sulfuric acid is made from sulfur trioxide.

.....
.....
.....
..... [2]

[Total: 15]

4 (a) Synthetic polymers are disposed of in landfill sites and by burning.

(i) Describe **two** problems caused by the disposal of synthetic polymers in landfill sites.

.....
 [2]

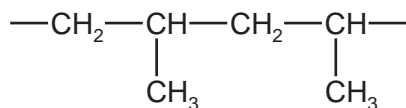
(ii) Describe **one** problem caused by burning synthetic polymers.

..... [1]

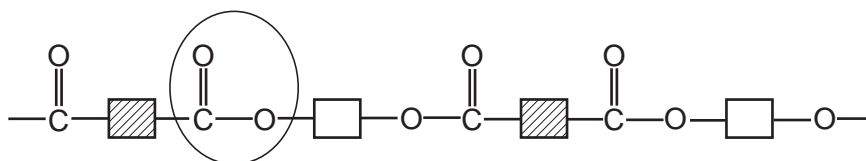
(b) State **two** uses of synthetic polymers.

.....
 [1]

(c) The structural formulae of two synthetic polymers are given below.



polymer A



polymer B

(i) Draw the structural formula of the monomer of polymer A.

[2]

(ii) Identify the functional group circled in polymer B.

..... [1]

(iii) Deduce the **two** types of organic compound which have reacted to form polymer B.

..... [2]

(d) Explain the difference between addition and condensation polymers. Classify **A** and **B** as either addition or condensation polymers.

.....

.....

.....

..... [3]

[Total: 12]

5 (a) A compound, **X**, contains 55.85% carbon, 6.97% hydrogen and 37.18% oxygen.

(i) How does this prove that compound **X** contains only carbon, hydrogen and oxygen?

..... [1]

(ii) Use the above percentages to calculate the empirical formula of compound **X**.

..... [2]

(iii) The M_r of **X** is 86.

What is its molecular formula?

..... [2]

(b) (i) Bromine water changes from brown to colourless when added to **X**.

What does this tell you about the structure of **X**?

..... [1]

(ii) Magnesium powder reacts with an aqueous solution of **X**. Hydrogen is evolved.

What does this tell you about the structure of **X**?

..... [1]

(iii) **X** contains two different functional groups.

Draw a structural formula of **X**.

[1]

[Total: 8]

6 Carbon and silicon are elements in Group IV. They both form oxides of the type XO_2 .

(a) Silicon(IV) oxide, SiO_2 , has a macromolecular structure.

(i) Describe the structure of silicon(IV) oxide.

.....
.....
.....
.....
..... [3]

(ii) State **three** properties which silicon(IV) oxide and diamond have in common.

.....
.....
..... [3]

(iii) How could you show that silicon(IV) oxide is acidic and not basic or amphoteric?

.....
.....
..... [2]

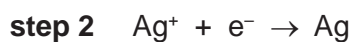
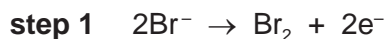
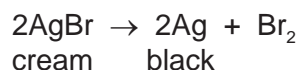
(b) Explain why the physical properties of carbon dioxide are different from those of diamond and silicon(IV) oxide.

.....
..... [1]

[Total: 9]

7 The rate of a photochemical reaction is affected by light.

(a) The decomposition of silver bromide is the basis of film photography. This is a redox reaction.



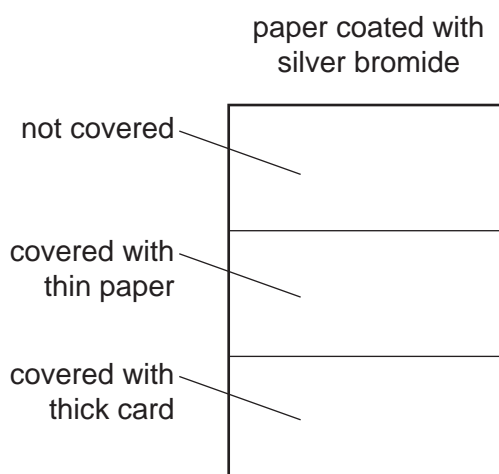
(i) Which step is reduction? Explain your answer.

..... [1]

(ii) Which ion is the oxidising agent? Explain your answer.

..... [1]

(b) A piece of white paper was coated with silver bromide and exposed to the light. Sections of the paper were covered as shown in the diagram.



Predict the appearance of the different sections of the paper after exposure to the light and the removal of the card. Explain your predictions.

.....

.....

.....

.....

.....

.....

..... [4]

(c) Photosynthesis is another example of a photochemical reaction. Green plants can make simple carbohydrates, such as glucose. These can polymerise to make more complex carbohydrates, such as starch.

(i) Write a word equation for photosynthesis.

..... [2]

(ii) Name the substance which is responsible for the colour in green plants and is essential for photosynthesis.

..... [1]

(iii) The structural formula of glucose can be represented by $\text{H}-\text{O}-\square-\text{O}-\text{H}$.

Draw part of the structural formula of starch which contains two glucose units.

[2]

(iv) Living organisms need carbohydrates for respiration.

What is meant by *respiration*?

..... [1]

[Total: 12]

DATA SHEET
The Periodic Table of the Elements

I		II										III										IV										V										VI										VII										0																																																																																																																																				
		Group		Group		Group		Group		Group		Group		Group		Group		Group		Group		Group		Group		Group		Group		Group		Group		Group																																																																																																																																																																
7	Li Lithium 3	9	Be Beryllium 4	1										H Hydrogen 1	11	B Boron 5	12	C Carbon 6	14	N Nitrogen 7	16	O Oxygen 8	19	F Fluorine 9	20	Ne Neon 10											4	He Helium 2	39	K Potassium 19	40	Ca Calcium 20	51	V Vanadium 23	52	Cr Chromium 24	55	Mn Manganese 25	56	Fe Iron 26	59	Co Cobalt 27	59	Ni Nickel 28	64	Cu Copper 29	65	Zn Zinc 30	70	Ga Gallium 31	73	Ge Germanium 32	75	As Arsenic 33	79	Se Selenium 34	80	Br Bromine 35	84	Kr Krypton 36	85	Rb Rubidium 37	88	Sr Strontium 38	89	Y Yttrium 39	91	Zr Zirconium 40	93	Nb Niobium 41	96	Mo Molybdenum 42	101	Ru Ruthenium 44	103	Rh Rhodium 45	106	Pd Palladium 46	108	Ag Silver 47	112	Cd Cadmium 48	115	In Indium 49	119	Sn Tin 50	122	Sb Antimony 51	127	I Iodine 53	131	Xe Xenon 54	133	Cs Caesium 55	137	Ba Barium 56	139	La Lanthanum 57	178	Hf Hafnium 72	181	Ta Tantalum 73	184	W Tungsten 74	190	Os Osmium 76	192	Ir Iridium 77	195	Pt Platinum 78	197	Au Gold 79	201	Hg Mercury 80	204	Tl Thallium 81	207	Pb Lead 82	209	Bi Bismuth 83	210	Po Polonium 84	210	At Astatine 85	226	Fr Francium 87	226	Ra Radium 88	227	Ac Actinium 89	86	Rn Radon 86	175	Lu Lutetium 71	173	Yb Ytterbium 70	169	Tm Thulium 69	167	Er Erbium 68	165	Ho Holmium 67	162	Dy Dysprosium 66	159	Tb Terbium 65	157	Gd Gadolinium 64	152	Eu Europium 63	150	Sm Samarium 62	144	Nd Neodymium 60	141	Pr Praseodymium 59	140	Ce Cerium 58	232	Th Thorium 90	238	U Uranium 92	238	Pu Plutonium 94	238	Np Neptunium 93	238	Am Americium 95	238	Cm Curium 96	238	Bk Berkelium 97	238	Cf Californium 98	238	Es Einsteinium 99	238	Fm Fermium 100	238	Md Mendelevium 101	238	No Nobelium 102	238	Lr Lawrencium 103

*58-71 Lanthanoid series
†90-103 Actinoid series

a	X
b	

a = relative atomic mass
 X = atomic symbol
 b = proton (atomic) number

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).